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A Prospective Comparative Study between Bone Biomarkers & DEXA Scan Absorptiometry in Diagnosis & Therapeutic post treatment follow up of Osteoporosis

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Abstract

Introduction: *We try to study the best method in diagnosis & therapeutic follow up post treatment respond in osteoporotic patients. Used the advantages of Dexa scan Absorptiometry and bone biomarkers for diagnosis & therapeutics post treatment follow up monitoring of osteoporotic patients were treated by different modalities.*

Methods: *Prospective comparative studies were randomized according to national osteoporotic foundation. Performed on 200 osteoporotic patients from March 2010 to April 2012, in private clinic sharing private Hematological and Dexa Scan Absorptiometry clinic in Sulaimaniyah city. All these patients with clinical sign of osteoporosis, also all of patients with history of osteoporotic fractures plus surgical history "Hysterectomy, Mastectomy, ooperectomy" were classified into two groups. Group A 100 patients used Dexa scan Absorptiometry for diagnosis & therapeutics treatment monitoring follow up. Group B100 patients were used bone biomarker "Vit D3, PTH, ALK, Osteocalcin" for evaluation & monitoring bone turnover used in diagnosis & therapeutic post treatment follow up of osteoporotic patients. The patients were follow up for 2 years period. The outcome measurements were according to Ancillary results scores of national osteoporotic foundations.*

Results: *In both group A & group B significant reduction in the mean of Ancillary results scores base line for both Dexa scan Absorptiometry & bone biomarkers were seen early & at 6 months ,1 year and 2 years follow up period visit of osteoporotic patients. Also, there were significant differences (p-value < 0.0001) to the same period of follow up between groups A there were used Dexa scan Absorptiometry as superior to bone biomarkers in diagnosis of osteoporotic patients. In Compared to group B depend on bone biomarkers there were superior in therapeutics post treatment follow up than Dexa scan Absorptiometry.*

Conclusions: *We concluded that Dexa scan Absorptiometry & Bone Biomarkers both are significant in diagnosis and post therapeutic treatment follow up of osteoporotic patients, However, Bone Biomarkersis superior in post therapeutic treatment than Dexa Scan Absorptiometry which is superior in diagnosis of osteoporotic patients for 2 years study follow up.*

Introduction

Osteoporosis is a silent disease until it is complicated by fractures that can occur following minimal trauma. The disease can be prevented, diagnosed and treated before any fracture occurs. Prevention, detection and treatment of

osteoporosis should be a mandate of primary care providers[1]. Osteoporosis is second only to cardiovascular disease as a leading health care problem, according to the World Health Organization. Worldwide, the lifetime risk for women to have an osteoporotic fracture is 30–40%[2]. Because of related morbidity, disability, diminished quality of life, and mortality, osteoporosis and fractures associated with it are major public health concern[3]. Since the National Osteoporosis Foundation NOF first published the Guide in 1999, it has become increasingly clear that many patients are not being given appropriate information about prevention; too many patients are not being prescribed any of the FDA-approved, effective therapies. This Guide offers concise recommendations regarding prevention, risk assessment, diagnosis and treatment of osteoporosis in postmenopausal women and men age 50 and older. It includes indications for bone densitometry and fracture risk thresholds for intervention with pharmacologic agents[1]. Dual-energy x-ray Absorptiometry (DXA) measurement of the hip and spine is the technology now used to establish or confirm a diagnosis of osteoporosis, predict future fracture risk and monitor patients by performing serial assessments[4].Bone Biomarkers are released into the circulation during the process of bone formation and resorption, providing information about the dynamic process of bone metabolism. During bone remodeling, bone formation by osteoblasts and bone resorption by osteoclasts are tightly coupled in time and space within the bone multicellular unit[5]. Drugs that promote bone formation (e.g. parathyroid hormone) increase biomarkers of formation and resorption, and drugs that inhibit resorption (e.g. Bisphosphonates) decrease biomarkers of formation and resorption[6]. Biomarkers of bone turnover predict fractures and changes in bone mineral density in adults, and can be used to monitor the effectiveness of therapy[7,8]. Numerous studies have demonstrated good correlations between biomarkers of bone metabolism and the actual rate of bone turnover, as quantified by calcium kinetics studies[9], or by histomorphometric analyses of labeled bone biopsies[10]. Although biochemical markers of bone turnover may be a more sensitive way of monitoring bone response, their use is subject to the previously noted limitations. Nevertheless, decreases in bone resorption markers measured 3 to 6 months after initiating antiresorptive therapy or increases in formation markers 1 to 3 months after starting anabolic therapy predict the subsequent increases in BMD and reduction in fracture rates and make them an attractive consideration as part of the clinical management of pharmacologic therapy[11]. Osteocalcin (OC), a bone-specific protein synthesized by the osteoblasts in bone, is the major non-collagen protein in the bone matrix. It has a molecular weight of 5,800 Da and contains 49 amino acids, including 3 gamma carboxyl glutamic acid residues that facilitate the binding of OC to hydroxyapatite in bone[12]. The serum OC level, a sensitive marker of bone production, is associated with a high bone turnover rate and decreased BMD, and correlates well with histomorphometric indices of bone formation[13].

Bone Markers of bone turnover are considered useful diagnostic tools for the evaluation of bone formation and resorption. We measured serum OC and total serum alkaline phosphatase (ALP) activity as markers of bone formation. The objectives of this study were to compare between these bone marrow markers and Dexa Scan in diagnosis and therapeutic follow up for predicting the osteoporosis by taking into consideration age, body mass index (BMI), and menopausal status. **What are Bone Biomarkers:** bone biomarker "Vit D3, PTH, ALK, C-Terminal Telopeptides, Osteocalcin" for evaluation & monitoring bone formation and resorption turnover in the blood as indicators for the osteoporosis level in the body.

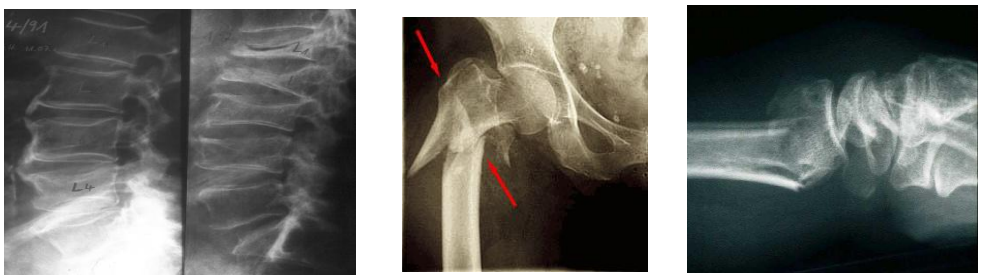


Fig.:1 Osteoporosis Fractures

Fig.2: Before Metabolic changes After Metabolic changes

Patients & Method

This is a prospective comparative study in Sulaimaniyah private clinic, to compare the dual X-ray Absorptiometry (DXA) scan and Bone Biomarkers in detection the most sensitive method for early diagnosis plus therapeutic post treatment follow up of osteoporosis. The bone Biomarkers include serum Osteocalcin, ALK bone specific alkaline phosphatase, Vit D3, PTH parathyroid hormonal assessments. For evaluation with monitoring bone turnover used in for both purposes of diagnosis & therapeutic post treatment follow up of osteoporotic patients, at early date, then at 6 months, 12 months, and 24 months. Were randomized according to NOF National Osteoporotic Foundation, performed on 200 osteoporotic patients from March 2010 to April 2012, were received in private orthopedic clinic sharing with private hematological and Dexa Scan Absorptiometry clinic in Sulaimaniyah city. All these patients with clinical sign of osteoporosis, also all of these patients with history of osteoporotic fractures plus surgical history "Hysterectomy, Mastectomy, ooperectomy" were classified into two groups. Group A 100 patients used Dexa scan Absorptiometry for diagnosis monitoring osteoporotic patients.

Fig 3: Dexa Scan Absorptiometry for Scanning the osteoporotic patients

Fig 4: Casa Bone Biomarkers Assessment

Table 1: WHO Definition of Osteoporosis Based on BMD

T-score	BMD	
T-score at -1.0 and above	Within 1 SD of a young-adult reference population	Normal
T-score between -1.0 and -2.5	Between 1.0 and 2.5 SD below that of a young-adult reference population	Low Bone Mass (Osteopenia)
T-score at or below -2.5	2.5 SD or more below that of a young- adult reference population	Osteoporosis
T-score at or below -2.5 with one or more fractures	2.5 SD or more below that of a young- adult reference population	Severe or Established Osteoporosis

Group B100 patients were used bone biomarker "Vit D3, PTH, ALK, Osteocalcin" for evaluation & monitoring bone formation and resorption turnover used both in diagnosis & therapeutic post treatment follow up of osteoporosis. The patients were following up for 2 years period, the outcome measurements were according to Ancillary results scores of national osteoporotic foundations.

T score — This number shows the amount of bone have compared with a young adult of the same gender with peak bone mass. A score above -1 is considered normal. A score between -1 and -2.5 is classified as osteopenia (low bone mass). A score below -2.5 is defined as osteoporosis. The T score is used to estimate the risk of developing fracture.

Results

We detected the early in diagnosis of 100 patients, the used Dexa Scan Absorptiometry there were 100% diagnosed as Osteoporosis, 85% diagnosis by Bone Biomarkers. However, 78% data changes were detected by Bone Biomarkers in compared to 33% detected by Dexa Scan Absorptiometry in post therapeutic treatments follow up osteoporotic patients after 24^{th} months. Also, we observed the Group A & Group B has significant reduction in the mean of Ancillary results scores from base line for both Dexa scan Absorptiometry & bone biomarkers were seen early and at 6, 12, and 24 months follow up period visit of osteoporotic patients. Also, there were significant differences (p-value < 0.0001) to the same period of follow up between groups A there were used Dexa scan Absorptiometry as superior to bone biomarkers in early visit for diagnosis of osteoporotic patients. In Compared to group B were depend on bone Biomarkers alone, there were superior in therapeutics post treatment follow up than the Dexa scan Absorptiometry observed by law rate of change at 6 months, then improved at 12 months, with return to normal in 24 months, while Dexa Scan Absorptiometry has little or no changes during same period of follow up. The high sensitive index of Biomarkers detection during follow up assessment at 6^{th}, 12^{th}, 24^{th} months as dependents data assessment of osteoporotic patients. As shown in the tables;

Table 2: Early in diagnosis

No	Age	Sex	Time of presentation (early in diagnosis)	Biomarkers			BMD Scan / T Score	
				PTH	VIT D	Osteocalcin	Lumbar	Femur
1	52	F	Early in diagnosis	66.24	5.3	12.75	-2.8	-2.6
2	54	F	Early in diagnosis	83.11	3.34	23.89	-2.5	-2.7
3	56	F	Early in diagnosis	66.17	9.82	12.35	-4.2	-3.9
4	53	F	Early in diagnosis	72.1	8.69	14.69	-3.5	-3.6
5	77	M	Early in diagnosis	83.45	7.99	17.14	-2.8	-2.8
6	82	F	Early in diagnosis	99.95	8.75	34.54	-2.6	-2.5
7	66	F	Early in diagnosis	66.16	9.14	25.38	-3.8	-4.4
8	63	F	Early in diagnosis	93.96	4.53	32.64	-3.1	-3.3
9	76	F	Early in diagnosis	79.39	2.97	37.2	-4.9	-3.9
10	83	M	Early in diagnosis	80.28	3.2	11.77	-4.6	-4.8
11	79	M	Early in diagnosis	66.2	9.56	20.06	-3.1	-3.0
12	59	F	Early in diagnosis	88.46	8.25	20.54	-4.0	-4.5
13	56	F	Early in diagnosis	88.7	6.46	57	-3.2	-3.1
14	62	F	Early in diagnosis	79.15	8.64	17.94	-3.9	-3.5
15	64	F	Early in diagnosis	79.58	<3	6.31	-4.2	-4.0
16	74	F	Early in diagnosis	99.05	2.46	141.3	-4.3	-4.7
17	53	F	Early in diagnosis	407.7	6.1	75.66	-3.2	-2.9
18	48	F	Early in diagnosis	74.82	7.72	37.31	-3.9	-2.9
19	57	F	Early in diagnosis	85.91	6.06	11.08	-3.8	-3.6
20	46	M	Early in diagnosis	65.87	9.17	22.62	-2.9	-2.7
21	49	F	Early in diagnosis	97.06	2.09	10.34	-3.8	-4.2
22	45	F	Early in diagnosis	77.25	3.27	7.77	-2.6	-2.8
23	65	F	Early in diagnosis	86.69	4.04	23.65	-3.8	-4.1
24	64	F	Early in diagnosis	82.86	6.56	22.34	-3.7	-3.4
25	68	F	Early in diagnosis	85.83	1.73	56.87	-4.5	-3.9
26	88	F	Early in diagnosis	98.3	4.94	25.45	-3.9	-4.0
27	74	F	Early in diagnosis	74.15	4.79	32.23	-3.6	-3.8
28	86	F	Early in diagnosis	84.48	6.87	19.94	-4.9	-4.7
29	77	F	Early in diagnosis	292.3	3.84	90.91	-3.5	-3.3
30	80	M	Early in diagnosis	90.2	2.22	22.5	-3.8	-3.4
31	78	F	Early in diagnosis	76.7	4.56	20.33	-3.4	-3.6
32	69	F	Early in diagnosis	88.2	6.05	21.98	-3.2	-3.5
33	46	F	Early in diagnosis	87.6	8.58	19.9	-2.9	-2.8
34	47	F	Early in diagnosis	280.5	3.37	29.19	-2.9	-2.5
35	78	M	Early in diagnosis	66.44	9.06	14.59	-3.1	-3.0
36	44	F	Early in diagnosis	70.6	2.32	51.56	-2.5	-2.6
37	49	F	Early in diagnosis	90.2	5.46	23.76	-2.8	-2.8
38	52	F	Early in diagnosis	107.3	4.47	13.08	-2.7	-2.9
39	65	F	Early in diagnosis	80.06	8.71	12.58	-3.2	-3.4
40	81	M	Early in diagnosis	90.06	6.17	11.05	-3.1	-3.3
41	64	F	Early in diagnosis	81.09	1.37	29.93	-4.2	-3.9
42	81	F	Early in diagnosis	67.02	9.56	29.66	-4.3	-4.6
43	78	F	Early in diagnosis	68.06	1.08	22.06	-3.8	-4.4
44	83	M	Early in diagnosis	103.5	7.69	29.36	-4.0	-3.6
45	82	M	Early in diagnosis	74.08	2.33	24.25	-3.8	-3.9
46	76	F	Early in diagnosis	70.01	9.22	20.06	-3.7	-3.7
47	75	F	Early in diagnosis	77.04	8.35	41.00	-3.3	-3.6
48	80	F	Early in diagnosis	109.6	1.49	33.35	-4.1	-4.4
49	47	F	Early in diagnosis	85.08	3.99	19.00	-3.3	-2.9
50	80	M	Early in diagnosis	140.8	9.85	38.87	-2.8	-2.5
51	68	F	Early in diagnosis	82.12	4.2	14.55	-3.6	-4.1
52	46	F	Early in diagnosis	66.07	9.38	25.67	-2.8	-2.7
53	47	F	Early in diagnosis	99.2	2.27	16.39	-2.9	-2.6
54	48	F	Early in diagnosis	88.5	7.49	17.43	-3.0	-2.8
55	69	F	Early in diagnosis	68.42	6.88	13.16	-4.0	-3.7
56	65	F	Early in diagnosis	93.65	9.55	31.14	-3.9	-4.3
57	70	F	Early in diagnosis	73.11	7.19	22.31	-3.8	-3.2
58	79	F	Early in diagnosis	86.16	8.24	36.42	-4.1	-4.3
59	77	M	Early in diagnosis	75.32	2.87	31.12	-4.2	-3.8
60	79	M	Early in diagnosis	88.20	3.4	16.87	-4.5	-4.9
61	68	F	Early in diagnosis	95.32	4.51	30.16	-3.8	-3.8
62	72	F	Early in diagnosis	85.47	6.35	26.64	-3.3	-3.5
63	72	F	Early in diagnosis	65.17	9.91	53.34	-4.0	-3.7
64	70	F	Early in diagnosis	79.15	6.24	13.45	-3.4	-3.6
65	48	F	Early in diagnosis	66.92	9.88	6.15	-3.1	-2.7
66	49	F	Early in diagnosis	85.04	2.42	15.23	-2.9	-3.8
67	67	F	Early in diagnosis	407.7	6.1	75.66	-3.3	-3.0
68	46	F	Early in diagnosis	66.82	9.72	37.31	-2.6	-2.9
69	49	F	Early in diagnosis	75.91	6.06	11.08	-2.8	-2.8

70	78	M	Early in diagnosis	68.87	5.7	22.62	-2.8	-2.5
71	81	M	Early in diagnosis	107.6	3.19	16.44	-3.5	-3.5
72	69	F	Early in diagnosis	77.15	3.37	17.77	-3.2	-4.7
73	67	F	Early in diagnosis	88.78	9.07	21.45	-3.8	-3.3
74	78	F	Early in diagnosis	80.80	4.56	26.23	-4.5	-4.8
75	63	F	Early in diagnosis	89.88	3.79	59.67	-3.2	-3.4
76	82	F	Early in diagnosis	67.13	9.79	23.35	-4.5	-4.5
77	77	F	Early in diagnosis	66.55	9.84	38.22	-3.2	-3.5
78	78	F	Early in diagnosis	71.48	7.87	14.94	-3.3	-3.7
79	76	F	Early in diagnosis	277.3	3.66	90.80	-4.2	-3.8
80	83	F	Early in diagnosis	98.2	6.32	42.25	-4.6	-4.6
81	43	F	Early in diagnosis	76.27	8.56	28.33	-2.8	-2.9
82	46	F	Early in diagnosis	67.02	9.05	27.78	-2.7	-3.8
83	66	F	Early in diagnosis	73.26	8.68	39.19	-3.0	-3.1
84	44	F	Early in diagnosis	230.8	3.67	27.59	-2.7	-2.9
85	78	M	Early in diagnosis	87.14	8.16	16.89	-2.5	-2.5
86	74	M	Early in diagnosis	74.6	4.42	61.76	-2.8	-3.0
87	72	F	Early in diagnosis	80.4	5.86	33.56	-3.2	-2.6
88	73	F	Early in diagnosis	102.3	4.67	19.68	-2.7	-3.3
89	78	F	Early in diagnosis	77.66	9.81	22.38	-3.9	-4.2
90	84	F	Early in diagnosis	66.06	9.17	14.55	-4.0	-4.1
91	79	F	Early in diagnosis	88.04	5.87	27.23	-4.2	-3.8
92	85	F	Early in diagnosis	78.52	2.57	25.06	-3.3	-4.3
93	77	F	Early in diagnosis	82.06	6.08	26.86	-3.6	-3.5
94	81	M	Early in diagnosis	113.5	8.67	26.31	-3.8	-3.9
95	80	M	Early in diagnosis	78.78	3.53	34.15	-2.5	-3.1
96	76	F	Early in diagnosis	78.11	5.62	28.36	-3.8	-3.7
97	75	F	Early in diagnosis	94.14	8.55	44.33	-4.5	-3.8
98	45	F	Early in diagnosis	129.6	2.44	34.75	-3.9	-4.4
99	48	F	Early in diagnosis	72.68	6.89	29.33	-2.8	-2.9
100	79	M	Early in diagnosis	134.8	6.25	27.67	-2.6	-2.6

Table 3: 6 months post therapy

No	Age	Sex	Time of Presentation (6^{th} months later)	Biomarkers			BMD Scan / T Score	
				PTH	VIT D	Osteocalcin	Lumbar	Femur
1	52	F	6^{th} months later	60.22	15.3	14.55	-2.7	-2.6
2	54	F	6^{th} months later	83.11	3.34	20.79	-2.5	-2.7
3	56	F	6^{th} months later	58.17	23.22	11.33	-4.2	-3.9
4	53	F	6^{th} months later	72.1	8.69	24.69	-3.5	-3.6
5	77	M	6^{th} months later	61.45	17.88	14.14	-2.8	-2.8
6	82	F	6^{th} months later	99.95	8.75	32.24	-2.6	-2.5
7	66	F	6^{th} months later	60.16	19.14	21.98	-3.2	-3.9
8	63	F	6^{th} months later	93.96	4.53	39.64	-3.1	-3.3
9	76	F	6^{th} months later	62.23	16.77	30.02	-4.9	-3.9
10	83	M	6^{th} months later	80.28	3.2	21.77	-4.6	-4.8
11	79	M	6^{th} months later	58.12	23.46	25.16	-3.1	-3.0
12	59	F	6^{th} months later	60.44	18.20	27.84	-4.0	-4.5
13	56	F	6^{th} months later	88.7	6.46	24.57	-3.2	-3.1
14	62	F	6^{th} months later	79.15	8.64	13.44	-3.9	-3.5
15	64	F	6^{th} months later	59.58	12.22	16.31	-4.2	-4.0
16	74	F	6^{th} months later	99.05	2.46	166.3	-4.3	-4.7
17	53	F	6^{th} months later	407.7	6.1	70.46	-3.2	-2.9
18	48	F	6^{th} months later	58.82	22.72	30.21	-3.9	-2.9
19	57	F	6^{th} months later	85.91	6.06	17.08	-3.8	-3.6
20	46	M	6^{th} months later	52.87	20.17	23.62	-2.9	-2.7
21	49	F	6^{th} months later	56.36	12.29	11.34	-3.8	-4.2
22	45	F	6^{th} months later	77.25	3.27	17.77	-2.6	-2.8
23	65	F	6^{th} months later	52.69	19.14	26.65	-3.8	-4.1
24	64	F	6^{th} months later	61.66	16.23	26.34	-2.9	-3.0
25	68	F	6^{th} months later	85.83	1.73	57.87	-4.5	-3.9
26	88	F	6^{th} months later	42.3	19.94	31.85	-3.9	-4.0
27	74	F	6^{th} months later	74.15	4.79	38.23	-3.6	-3.8
28	86	F	6^{th} months later	40.33	20.77	18.54	-4.9	-4.7

29	77	F	6th months later	124.1	13.84	80.81	-3.5	-3.3
30	80	M	6th months later	90.2	2.22	24.15	-3.8	-3.4
31	78	F	6th months later	76.7	4.56	24.39	-3.1	-3.2
32	69	F	6th months later	42.22	16.05	27.78	-3.2	-3.5
33	46	F	6th months later	87.6	8.58	16.19	-2.9	-2.8
34	47	F	6th months later	280.5	3.37	28.29	-2.9	-2.5
35	78	M	6th months later	45.4	12.06	16.19	-3.1	-3.0
36	44	F	6th months later	70.6	2.32	54.86	-2.5	-2.6
37	49	F	6th months later	90.2	5.46	21.96	-2.8	-2.8
38	52	F	6th months later	107.3	4.47	18.18	-2.7	-2.9
39	65	F	6th months later	40.16	18.71	16.68	-3.2	-3.4
40	81	M	6th months later	90.06	6.17	15.05	-3.1	-3.3
41	64	F	6th months later	41.19	17.37	27.83	-4.2	-3.9
42	81	F	6th months later	87.02	5.56	24.66	-4.3	-4.6
43	78	F	6th months later	68.06	1.08	26.06	-3.8	-4.4
44	83	M	6th months later	103.5	7.69	27.56	-4.0	-3.6
45	82	M	6th months later	55.18	22.33	21.25	-3.8	-3.9
46	76	F	6th months later	70.01	9.22	28.16	-3.7	-3.7
47	75	F	6th months later	44.14	18.35	44.00	-3.3	-3.6
48	80	F	6th months later	109.6	1.49	36.55	-4.0	-4.1
49	47	F	6th months later	85.08	3.99	18.10	-3.3	-2.9
50	80	M	6th months later	140.8	9.85	37.77	-2.8	-2.5
51	68	F	6th months later	42.12	14.2	13.45	-3.6	-4.1
52	46	F	6th months later	69.17	2.38	22.07	-2.8	-2.7
53	47	F	6th months later	99.2	2.27	15.49	-2.9	-2.6
54	48	F	6th months later	43.5	17.49	11.43	-3.0	-2.8
55	69	F	6th months later	68.42	6.88	16.16	-4.0	-3.7
56	65	F	6th months later	93.65	9.55	35.04	-3.9	-4.3
57	70	F	6th months later	73.11	7.19	23.32	-3.8	-3.2
58	79	F	6th months later	86.16	8.24	38.92	-3.9	-4.1
59	77	M	6th months later	39.22	22.87	36.02	-4.2	-3.8
60	79	M	6th months later	88.20	3.4	17.67	-4.5	-4.9
61	68	F	6th months later	95.32	4.51	33.06	-3.8	-3.8
62	72	F	6th months later	85.47	6.35	20.34	-3.3	-3.5
63	72	F	6th months later	75.17	6.11	56.44	-4.0	-3.7
64	70	F	6th months later	79.15	6.24	15.45	-3.4	-3.6
65	48	F	6th months later	70.52	<3	26.11	-3.1	-2.7
66	49	F	6th months later	85.04	2.42	18.29	-2.9	-3.8
67	67	F	6th months later	96.7	16.11	79.06	-3.3	-3.0
68	46	F	6th months later	71.82	2.72	35.51	-2.5	-2.7
69	49	F	6th months later	45.81	16.06	18.08	-2.8	-2.8
70	78	M	6th months later	68.87	5.7	23.92	-2.8	-2.5
71	81	M	6th months later	107.6	3.19	19.04	-3.5	-3.5
72	69	F	6th months later	56.15	13.37	19.17	-3.2	-4.7
73	67	F	6th months later	88.78	9.07	20.55	-3.8	-3.3
74	78	F	6th months later	80.80	4.56	20.33	-4.5	-4.8
75	63	F	6th months later	89.88	3.79	50.97	-3.2	-3.4
76	82	F	6th months later	67.3	6.99	28.55	-4.5	-4.5
77	77	F	6th months later	46.65	18.74	39.02	-3.2	-3.5
78	78	F	6th months later	71.48	7.87	17.94	-3.3	-3.7
79	76	F	6th months later	277.3	3.66	90.80	-4.2	-3.8
80	83	F	6th months later	43.2	16.32	49.15	-4.6	-4.6
81	43	F	6th months later	76.27	8.56	29.33	-2.8	-2.9
82	46	F	6th months later	68.2	6.05	29.88	-2.7	-3.8
83	66	F	6th months later	42.26	18.68	33.99	-3.0	-3.1
84	44	F	6th months later	98.18	13.67	28.59	-2.7	-2.9
85	78	M	6th months later	87.14	8.16	18.19	-2.5	-2.5
86	74	M	6th months later	74.6	4.42	66.96	-2.8	-3.0
87	72	F	6th months later	80.4	5.86	39.46	-3.2	-2.6
88	73	F	6th months later	102.3	4.67	14.98	-2.7	-3.3
89	78	F	6th months later	39.66	19.81	27.38	-3.9	-4.2
90	84	F	6th months later	68.06	6.17	12.85	-4.0	-4.1
91	79	F	6th months later	88.04	5.87	28.23	-4.2	-3.8
92	85	F	6th months later	78.52	2.57	29.06	-3.3	-4.3
93	77	F	6th months later	82.06	6.08	20.96	-3.6	-3.5
94	81	M	6th months later	113.5	8.67	28.39	-3.8	-3.9
95	80	M	6th months later	78.78	3.53	36.85	-2.5	-3.1
96	76	F	6th months later	38.21	15.62	25.26	-3.8	-3.7
97	75	F	6th months later	94.14	8.55	41.13	-4.0	-3.0
98	45	F	6th months later	129.6	2.44	33.75	-3.9	-4.4
99	48	F	6th months later	72.68	6.89	28.83	-2.8	-2.9
100	79	M	6th months later	134.8	6.25	29.07	-2.6	-2.6

Table 4: 12 months post therapy

No	Age	Sex	Time of Presentation (12 months later)	Biomarkers			BMD Scan / T Score	
				PTH	VIT D	Osteocalcin	Lumbar	Femur
1	52	F	12 months later	60.22	15.3	22.65	-2.7	-2.6
2	54	F	12 months later	83.11	3.34	29.59	-2.5	-2.7
3	56	F	12 months later	62.7	13.22	17.55	-4.2	-3.9
4	53	F	12 months later	60.11	18.69	14.69	-3.1	-3.0
5	77	M	12 months later	63.45	17.99	19.19	-2.8	-2.8
6	82	F	12 months later	61.55	19.75	38.34	-2.6	-2.5
7	66	F	12 months later	60.16	19.14	27.88	-3.2	-3.9
8	63	F	12 months later	93.96	4.53	30.04	-3.1	-3.3
9	76	F	12 months later	52.99	12.77	38.22	-4.9	-3.9
10	83	M	12 months later	60.12	13.12	15.97	-4.6	-4.8
11	79	M	12 months later	61.2	18.56	26.06	-3.1	-3.0
12	59	F	12 months later	53.44	20.55	20.04	-3.8	-3.9
13	56	F	12 months later	88.7	6.46	21.57	-3.2	-3.1
14	62	F	12 months later	51.45	19.64	18.54	-3.9	-3.5
15	64	F	12 months later	54.23	9.22	16.11	-4.2	-4.0
16	74	F	12 months later	99.05	2.46	161.3	-4.3	-4.7
17	53	F	12 months later	87.15	16.11	85.66	-3.2	-2.9
18	48	F	12 months later	58.82	17.72	36.01	-3.3	-2.8
19	57	F	12 months later	50.88	16.06	17.18	-3.8	-3.6
20	46	M	12 months later	52.87	15.7	21.92	-2.9	-2.7
21	49	F	12 months later	49.16	14.19	19.04	-3.8	-4.2
22	45	F	12 months later	48.20	13.37	11.07	-2.6	-2.8
23	65	F	12 months later	56.69	14.04	24.35	-3.8	-4.1
24	64	F	12 months later	44.66	16.76	27.94	-2.9	-3.0
25	68	F	12 months later	55.33	17.22	59.47	-4.5	-3.9
26	88	F	12 months later	48.3	14.94	21.25	-3.9	-4.0
27	74	F	12 months later	47.55	14.79	39.03	-3.6	-3.8
28	86	F	12 months later	46.47	16.87	14.04	-4.2	-4.0
29	77	F	12 months later	78.11	20.44	92.81	-3.5	-3.3
30	80	M	12 months later	90.2	2.22	24.15	-3.8	-3.4
31	78	F	12 months later	76.7	4.56	29.43	-3.1	-3.2
32	69	F	12 months later	42.22	16.05	28.88	-3.2	-3.5
33	46	F	12 months later	87.6	8.58	16.19	-2.9	-2.8
34	47	F	12 months later	280.5	3.37	27.09	-2.9	-2.5
35	78	M	12 months later	45.4	12.06	13.29	-3.1	-3.0
36	44	F	12 months later	70.6	2.32	58.86	-2.5	-2.5
37	49	F	12 months later	55.12	15.46	29.86	-2.8	-2.8
38	52	F	12 months later	107.3	4.47	15.08	-2.7	-2.9
39	65	F	12 months later	40.16	18.71	19.88	-3.2	-3.4
40	81	M	12 months later	90.06	6.17	18.05	-3.1	-3.3
41	64	F	12 months later	41.19	17.37	28.93	-4.2	-3.9
42	81	F	12 months later	61.02	11.56	27.96	-4.3	-4.6
43	78	F	12 months later	68.06	1.08	28.06	-3.2	-3.9
44	83	M	12 months later	103.5	7.69	20.36	-4.0	-3.6
45	82	M	12 months later	55.18	22.33	29.15	-3.8	-3.9
46	76	F	12 months later	57.11	19.82	20.06	-3.7	-3.7
47	75	F	12 months later	44.14	18.35	45.00	-3.3	-3.6
48	80	F	12 months later	109.6	1.49	37.55	-4.0	-4.1
49	47	F	12 months later	85.08	3.99	16.90	-3.3	-2.9
50	80	M	12 months later	140.8	9.85	31.77	-2.8	-2.5
51	68	F	12 months later	42.12	14.2	11.95	-3.6	-4.1
52	46	F	12 months later	62.07	10.99	22.77	-2.8	-2.7
53	47	F	12 months later	56.12	17.47	18.59	-2.9	-2.6
54	48	F	12 months later	43.5	17.49	16.73	-3.0	-2.8
55	69	F	12 months later	68.42	6.88	19.26	-4.0	-3.7
56	65	F	12 months later	93.65	9.55	38.14	-3.9	-4.3
57	70	F	12 months later	73.11	7.19	29.01	-3.8	-3.2
58	79	F	12 months later	86.16	8.24	30.42	-3.9	-4.1
59	77	M	12 months later	39.22	22.87	30.02	-4.2	-3.8
60	79	M	12 months later	88.20	3.4	19.77	-4.5	-4.9
61	68	F	12 months later	95.32	4.51	38.86	-3.8	-3.8
62	72	F	12 months later	85.47	6.35	29.64	-3.3	-3.5
63	72	F	12 months later	64.77	11.11	58.54	-3.7	-3.1
64	70	F	12 months later	79.15	6.24	11.55	-3.4	-3.6
65	48	F	12 months later	50.22	9.33	16.15	-3.1	-2.7
66	49	F	12 months later	85.04	2.42	18.93	-2.9	-3.8
67	67	F	12 months later	66.17	16.11	78.06	-3.3	-3.0

68	46	F	12 months later	64.82	10.72	33.01	-2.5	-2.7
69	49	F	12 months later	45.81	16.06	19.08	-2.8	-2.8
70	78	M	12 months later	68.87	5.7	27.92	-2.8	-2.5
71	81	M	12 months later	107.6	3.19	19.44	-3.5	-3.5
72	69	F	12 months later	56.15	13.37	18.07	-3.0	-4.0
73	67	F	12 months later	51.88	19.17	23.45	-3.8	-3.3
74	78	F	12 months later	80.80	4.56	24.03	-4.5	-4.8
75	63	F	12 months later	89.88	3.79	55.67	-3.2	-3.4
76	82	F	12 months later	63.13	10.99	27.65	-4.5	-4.5
77	77	F	12 months later	46.65	16.74	37.92	-3.2	-3.5
78	78	F	12 months later	71.48	7.87	19.94	-3.3	-3.7
79	76	F	12 months later	277.3	3.66	90.80	-3.9	-3.2
80	83	F	12 months later	43.2	16.32	48.55	-4.6	-4.6
81	43	F	12 months later	76.27	8.56	23.23	-2.8	-2.9
82	46	F	12 months later	64.12	10.05	26.88	-2.7	-3.8
83	66	F	12 months later	42.26	18.68	35.99	-3.0	-3.1
84	44	F	12 months later	61.28	19.67	28.99	-2.7	-2.9
85	78	M	12 months later	49.44	18.66	19.09	-2.5	-2.5
86	74	M	12 months later	74.6	4.42	69.76	-2.8	-3.0
87	72	F	12 months later	80.4	5.86	30.06	-2.8	-2.5
88	73	F	12 months later	102.3	4.67	14.98	-2.7	-3.3
89	78	F	12 months later	39.66	19.81	28.98	-3.9	-4.2
90	84	F	12 months later	63.06	10.17	19.95	-4.0	-4.1
91	79	F	12 months later	88.04	5.87	29.83	-4.2	-3.8
92	85	F	12 months later	78.52	2.57	29.06	-3.3	-4.3
93	77	F	12 months later	82.06	6.08	23.46	-3.6	-3.5
94	81	M	12 months later	113.5	8.67	20.09	-3.3	-3.1
95	80	M	12 months later	78.78	3.53	39.25	-2.5	-3.1
96	76	F	12 months later	38.21	15.62	23.96	-3.8	-3.7
97	75	F	12 months later	94.14	8.55	48.03	-4.0	-3.0
98	45	F	12 months later	55.00	17.22	39.45	-3.9	-4.4
99	48	F	12 months later	72.68	6.89	28.03	-2.8	-2.9
100	79	M	12 months later	134.8	6.25	24.97	-2.6	-2.6

Table 5: 24 months post therapy

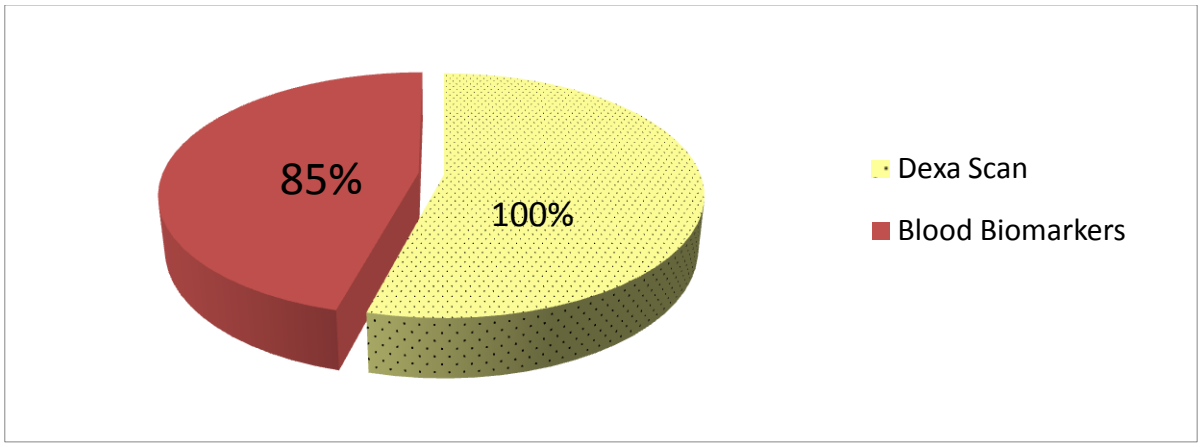
No	Age	Sex	Time of Presentation (24^{th} months later)	Biomarkers			BMD Scan / T Score	
				PTH	VIT D	Osteocalcin	Lumbar	Femur
1	52	F	24 months later	59.12	21.13	11.05	-2.3	-2.2
2	54	F	24 months later	60.51	13.34	22.99	-2.5	-2.7
3	56	F	24 months later	51.17	23.12	18.75	-4.2	-3.9
4	53	F	24 months later	52.41	26.99	16.99	-2.4	-2.1
5	77	M	24 months later	48.55	31.19	15.04	-2.8	-2.8
6	82	F	24 months later	49.35	29.55	33.44	-2.1	-2.0
7	66	F	24 months later	52.66	20.33	26.98	-2.4	-2.6
8	63	F	24 months later	62.66	14.53	39.84	-3.1	-3.3
9	76	F	24 months later	42.49	32.27	36.02	-4.9	-3.9
10	83	M	24 months later	44.32	23.22	18.17	-2.3	-2.4
11	79	M	24 months later	42.12	33.66	20.06	-3.1	-3.0
12	59	F	24 months later	43.14	30.45	21.04	-2.8	-2.9
13	56	F	24 months later	59.17	16.34	22.57	-3.2	-3.1
14	62	F	24 months later	41.55	28.44	18.44	-3.9	-3.5
15	64	F	24 months later	44.13	29.32	21.31	-2.7	-2.2
16	74	F	24 months later	51.15	12.03	181.3	-4.3	-4.7
17	53	F	24 months later	53.15	26.31	66.66	-3.2	-2.9
18	48	F	24 months later	41.22	27.52	38.01	-2.3	-2.4
19	57	F	24 months later	40.68	26.16	19.08	-3.8	-3.6
20	46	M	24 months later	43.77	28.33	20.02	-2.9	-2.7
21	49	F	24 months later	41.76	34.79	14.44	-2.3	-2.8
22	45	F	24 months later	34.30	35.77	17.77	-2.0	-1.8
23	65	F	24 months later	41.99	29.14	25.85	-3.8	-4.1
24	64	F	24 months later	39.16	34.66	20.84	-2.1	-2.0
25	68	F	24 months later	38.13	36.12	57.77	-4.5	-3.9
26	88	F	24 months later	39.13	37.44	22.25	-3.9	-4.0
27	74	F	24 months later	42.15	26.69	32.23	-3.6	-3.8
28	86	F	24 months later	40.77	32.67	18.54	-3.0	-2.8
29	77	F	24 months later	58.14	31.64	99.11	-3.5	-3.3
30	80	M	24 months later	56.12	12.52	28.55	-2.0	-2.1

31	78	F	24 months later	76.7	4.56	29.13	-2.5	-2.3
32	69	F	24 months later	38.62	26.25	27.88	-3.2	-3.5
33	46	F	24 months later	45.16	18.88	15.09	-2.9	-2.8
34	47	F	24 months later	60.15	16.77	25.99	-2.9	-2.5
35	78	M	24 months later	39.14	27.06	17.69	-3.1	-3.0
36	44	F	24 months later	54.16	16.32	55.66	-2.1	-2.0
37	49	F	24 months later	45.22	21.66	28.06	-2.8	-2.8
38	52	F	24 months later	99.13	7.47	18.18	-2.7	-2.9
39	65	F	24 months later	36.66	28.11	17.88	-2.0	-2.2
40	81	M	24 months later	59.26	16.17	16.15	-3.1	-3.3
41	64	F	24 months later	35.29	27.17	28.03	-4.2	-3.9
42	81	F	24 months later	87.02	5.56	28.16	-4.3	-4.6
43	78	F	24 months later	57.26	23.28	26.36	-2.0	-2.2
44	83	M	24 months later	60.15	17.69	25.96	-4.0	-3.6
45	82	M	24 months later	42.28	22.13	22.15	-3.8	-3.9
46	76	F	24 months later	46.31	27.12	28.96	-3.7	-3.7
47	75	F	24 months later	42.44	28.55	48.00	-3.3	-3.6
48	80	F	24 months later	61.16	19.89	35.35	-2.0	-2.2
49	47	F	24 months later	85.08	3.99	18.90	-3.3	-2.9
50	80	M	24 months later	60.18	19.55	35.77	-2.8	-2.5
51	68	F	24 months later	42.12	21.12	10.45	-3.6	-4.1
52	46	F	24 months later	58.77	17.88	22.87	-2.3	-2.1
53	47	F	24 months later	46.22	27.47	18.99	-2.9	-2.6
54	48	F	24 months later	43.5	27.49	18.93	-3.0	-2.8
55	69	F	24 months later	49.22	16.78	18.46	-3.0	-2.8
56	65	F	24 months later	93.65	9.55	30.54	-3.9	-4.3
57	70	F	24 months later	46.33	17.29	28.81	-3.8	-3.2
58	79	F	24 months later	86.16	8.24	38.92	-2.4	-2.3
59	77	M	24 months later	39.33	22.77	38.22	-4.2	-3.8
60	79	M	24 months later	59.12	16.14	18.77	-4.5	-4.9
61	68	F	24 months later	95.32	4.51	39.76	-2.2	-2.1
62	72	F	24 months later	85.47	6.35	25.44	-3.3	-3.5
63	72	F	24 months later	55.17	16.11	58.84	-2.0	-1.9
64	70	F	24 months later	49.55	16.24	14.55	-3.4	-3.6
65	48	F	24 months later	40.12	19.23	26.95	-3.1	-2.7
66	49	F	24 months later	51.24	17.22	19.23	-1.8	-2.0
67	67	F	24 months later	49.37	24.41	65.96	-3.3	-3.0
68	46	F	24 months later	52.22	32.32	33.30	-1.7	-1.5
69	49	F	24 months later	45.11	26.36	14.18	-2.8	-2.8
70	78	M	24 months later	43.67	15.47	21.02	-2.2	-2.4
71	81	M	24 months later	107.6	3.19	15.84	-3.5	-3.5
72	69	F	24 months later	46.35	23.77	18.07	-1.2	-1.2
73	67	F	24 months later	41.88	29.17	25.85	-3.8	-3.3
74	78	F	24 months later	50.00	17.66	21.03	-4.5	-4.8
75	63	F	24 months later	89.88	3.79	50.07	-3.2	-3.4
76	82	F	24 months later	44.00	16.19	20.25	-3.2	-3.4
77	77	F	24 months later	46.65	18.74	30.02	-3.2	-3.5
78	78	F	24 months later	71.48	7.87	19.74	-3.3	-3.7
79	76	F	24 months later	167.3	7.66	99.70	-1.3	-1.8
80	83	F	24 months later	43.2	26.32	44.55	-4.6	-4.6
81	43	F	24 months later	46.77	18.56	26.53	-2.8	-2.9
82	46	F	24 months later	68.2	6.05	28.98	-2.7	-3.8
83	66	F	24 months later	42.26	28.68	39.59	-2.7	-2.8
84	44	F	24 months later	41.78	28.00	21.09	-2.7	-2.9
85	78	M	24 months later	49.44	28.66	18.59	-2.0	-1.8
86	74	M	24 months later	42.16	14.22	60.06	-2.8	-3.0
87	72	F	24 months later	80.4	5.86	34.96	-1.6	-1.8
88	73	F	24 months later	102.3	4.67	18.88	-2.7	-3.3
89	78	F	24 months later	39.66	27.11	24.18	-3.9	-4.2
90	84	F	24 months later	48.00	16.10	18.05	-2.2	-2.0
91	79	F	24 months later	88.04	5.87	29.03	-4.2	-3.8
92	85	F	24 months later	43.02	19.00	27.96	-3.3	-4.3
93	77	F	24 months later	82.06	6.08	25.66	-3.6	-3.5
94	81	M	24 months later	113.5	8.67	24.81	-2.0	-1.6
95	80	M	24 months later	78.78	3.53	37.05	-2.5	-3.1
96	76	F	24 months later	38.00	25.00	23.96	-3.8	-3.7
97	75	F	24 months later	94.14	8.55	48.93	-1.9	-1.1
98	45	F	24 months later	44.00	27.02	34.85	-3.9	-4.4
99	48	F	24 months later	72.68	6.89	27.13	-2.5	-2.6
100	79	M	24 months later	134.8	6.25	28.77	-2.1	-2.0

We detected the Dexa scan Absorptiometry are superior & more sensitive from the index data of same 100 Osteoporotic patients in early diagnosis 100% compared to bone biomarkers in diagnostic fact which is reach to 85%. Also, we detected 33% after 24 months in post therapy treatment follow up for Dexa scan Compare to 78% in bone biomarkers to same patients, also for the same follow up period rates times, which is more sensitive index scores in osteoporotic patients.

Table 6: Total changes 24th months *Dexa Scan & Blood Biomarkers*

	Dexa Scan	***Blood Biomarkers***
No. of patients	**100**	**100**
Early / Diagnosis	**100%**	**85 %**
6 Months	8 %	24 %
12 Months	11 %	28 %
Total changes % / Data Changes 2 years	33 %	78 %
P VALUE	0.08	<0.0001



Pia chart: 100 patients Pia chart showing Dexa scan diagnostic compare to Blood Biomarkers early diagnosis in patients

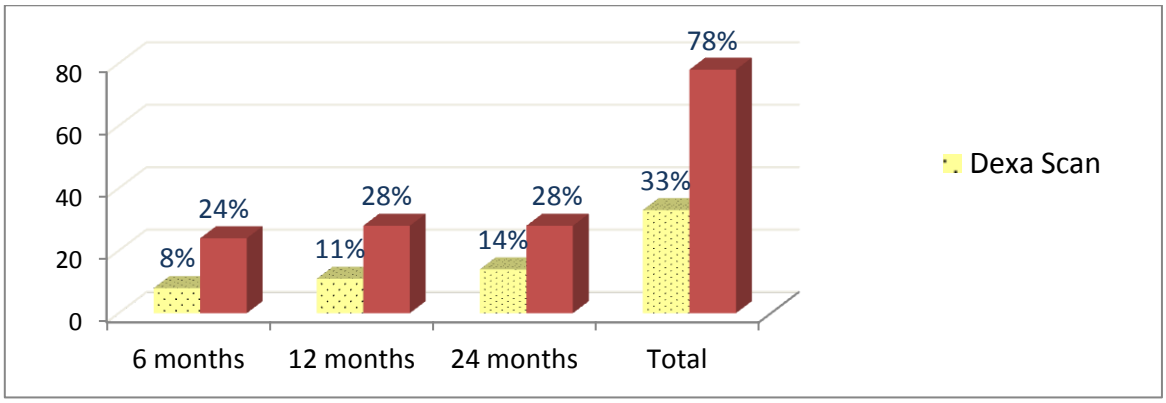


Figure 5: Post treatment follow up

Discussion

Osteoporosis is a systemic disease characterized by low bone mass and microarchitectural deterioration of bone tissue, resulting in an increased risk of fracture. While the level of bone mass can be estimated by measuring bone mineral density (BMD) using dual X-ray absorptiometry (DXA), its measurement does not capture all the risk factors for fracture. Quantitative changes in skeletal turnover can be assessed easily and non-invasively by the measurement of serum and urinary biochemical markers; the most sensitive markers include serum osteocalcin, bone specific alkaline phosphatase, Vitamin D3, Parathyroid Hormone PTH assessments.

MICHAEL P. J.etal, support our study, they recommend using dual energy x-ray absorptiometry to screen all women 65 years and older evidence to recommend screening for osteoporosis in patients with newly diagnosed osteoporosis, suggested laboratory tests to identify secondary causes include serum 25-hydroxyvitamin D, calcium, creatinine, and thyroid-stimulating hormone[14,15,16,17,18]. After initiation of treatment, the need for follow-up bone density testing is uncertain. These confirmed our results data requirements of Bone Biomarkers as diagnostic factors during follow up treatments. these supportive ideas confirm our study results data[19,20].WHOWorld Health Organization. Assessment of fracture risk osteoporotic patients, Kanis J., they evaluated other methods for diagnosing osteoporosis that have been used extensively in clinical trials and epidemiological studies. These include radiological assessments and Bone Turnover Markers (BTM). These supported our study to use the Dexa Scan Absorptiometry plus Bone Biomarkers both in diagnostic & Therapeutic follow up of Osteoporotic patients with proper method of evaluation which is for diagnosis, plus which is for treatment follow up[21,22]. Combination BMD with BTM could improve fracture prediction in postmenopausal women. One advantage of biochemical markers compared to BMD is early estimation of treatment effect. Significant changes in BTM can be seen during antiresorptive therapy after a few weeks of treatment; whereas individual monitoring with DXA usually requires 1-2 years to identify significant changes. As adherence is an important issue of long-term therapy in chronic disease, it has been suggested that BTM could be used in clinical practice to assess the patient's adherence to treatment and also provide feedback on the effectiveness of the medication[23,24,25,26]. In Our study confirm the usage these two methods, theDexa Scan Absorptiometry & Bone Biomarkersduring diagnostic criteria, plus evaluation during post therapeutic treatment follow up. The Dexa Scan Absorptiometry are more sensitive index in diagnostic determination, plus Bone Biomarkers method are superior in post therapeutic treatment follow up of osteoporotic patients.

Conclusions

We concluded that Dexa Scan Absorptiometry is superior in diagnosis of Osteoporosis than Bone Biomarkers evaluation in compared to Bone Biomarkers are superior in Therapeutic Post Treatment Monitoring for 2 years follow up of Osteoporotic Patients.

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